REMARKS

Upon entry of this amendment, claims 1-10, 12-22, 24, 25, 33-45 and 56-89 will be pending in the application; of which claims 1-3, 10, 12, 17, 19, 21-22, 33-34, 38-39, 41-42 and 44 are being amended, and claims 56-89 are being added.

The claim amendments and added claims are supported by the Specification, original claims, and Drawings as originally filed. Thus, no new matter is added, and entry of the amendments and added claims is respectfully requested.

Reconsideration of the present application is respectfully requested in view of the amendments and arguments made herein.

Objection Under 37 C.F.R. §1.121(c)

The Examiner objected to claims 26-32 and 46-55 under 37 C.F.R. §1.121(c) for non-compliance because claims 26-32 were identified as "withdrawn" in the Amendment filed on September 22, 2005, however, these claims had been previously canceled in the Amendment of August 23, 2002. Applicant has now corrected this inadvertent error and correctly identified claims 26-32 to reflect their cancellation.

The Examiner also objected to claims 46-55 which were identified as withdrawn in the amendment to the claims filed on September 22, 2005, because these claims had been previously "canceled" in the Examiner's amendment of February 19, 2004. Applicant has now currently identified claims 46-55 to reflect their cancellation.

Examiner objected to claim 44 stating that the changes to claim 44, as per the Examiner's amendment on February 19, 2004, were not reflected in the previous amendment filed on September 22, 2005. Applicant has now amended claim 44 to reflect the Examiner's amendments.

Amendments in View of Takeuchi et al.

In a telephone interview conducted on February 17th, 2006, the Examiner cited a new reference, United States Patent No. 5,824,158 (hereinafter, Takeuchi et al.) The Takeuchi et al. reference has been distinguished by claim amendments as provided below.

Claims 1-9

Takeuchi et al. does not teach independent claim 1 as amended, which recites a method of processing a substrate, the method comprising providing a substrate in a process chamber, the substrate having a surface, introducing a gas into the process chamber, energizing the gas by applying an RF current through a multi-turn antenna above an external surface of a wall of the process chamber to pass RF energy through the external surface of the wall of the process chamber to couple the RF energy to the gas inside the process chamber to energize the gas, detecting radiation from directly above the surface of the substrate after the radiation propagates through the wall and the external surface of the process chamber, and evaluating the detected radiation to monitor the depth of a layer being processed on the substrate.

In one embodiment, Takeuchi et al. teaches detecting radiation through a viewing port of a chamber having "an antenna formed in a loop..." (Takeuchi et al. col. 7, lines 30-31 and 65-66.) The singular form "a loop" would suggest a single loop. Furthermore, Figures 7 and 8 of Takeuchi et al. both of which show the process monitoring device, also show that the antenna loop is a single-turn coil. Thus, Takeuchi et al. does not teach energizing the gas by applying an RF current through a multi-turn antenna and detecting radiation from directly above the surface of the substrate after the radiation propagates through the wall and the external surface of the process chamber, as claimed in claim 1.

Claims 10 and 12-16

Takeuchi et al. does not teach independent claim 10 which is to a substrate processing method comprising, inter alia, applying an RF current through a multi-turn antenna above an external surface of a portion of a ceiling of the process chamber facing the substrate to inductively couple RF energy through a portion of the ceiling of the process chamber to the gas inside the process chamber to energize the gas, detecting radiation from directly above the surface of the substrate after the radiation propagates through a window in the portion of the ceiling facing the substrate, and evaluating the detected radiation to monitor the depth of a layer being processed on the substrate. Instead, Takeuchi et al. teaches detecting radiation in the context of an antenna comprising a single loop. Furthermore, Figures 7 and 8 of Takeuchi et al. both of which show the process monitoring device, also show that the antenna loop is a single-turn coil. Thus, Takeuchi et al. does not teach energizing the gas by applying an RF current through a multi-turn antenna and detecting radiation from directly above the surface of the substrate, as claimed in claim 10 and its dependent claims.

Claims 17-20

Takeuchi et al. does not teach claim 17, which is to a method of processing a substrate, the method comprising providing a chamber having a wall, the wall comprising an external surface that is at least partially dome shaped. A substrate is provided in the chamber, the substrate having a surface, and a gas is introduced into the chamber. RF energy is inductively coupled to the gas in the chamber by passing the RF energy from above the at least partially domed external surface to the gas inside the chamber. Radiation is monitored from directly above a surface of the substrate, the radiation propagating through the at least partially domed external surface during processing of the substrate. The monitored radiation is evaluated to monitor the depth of a layer being processed on the substrate. In the process monitoring device description, Takeuchi et al. teaches monitoring radiation through a wall of a flat ceiling and not through a wall comprising an external surface that is at least partially domed

shaped, as claimed in claim 17. Thus, Takeuchi et al. does not teach claim 17 or the claims dependent therefrom.

Claims 21-25

Takeuchi et al. does not teach claim 21 which is to a method of processing a substrate, the method comprising applying an RF current through a multi-turn antenna to pass RF energy from outside an external surface of a portion of the ceiling of the first enclosure facing the substrate to the process gas inside the first enclosure to energize the process gas; and monitoring radiation from directly above the surface of the substrate from after the radiation has propagated through the portion of the ceiling and external surface of the first enclosure facing the substrate and into a second enclosure disposed above the first enclosure to monitor the depth of a layer being processed on the substrate to determine a process endpoint. Instead Takeuchi et al. teaches a single loop. Furthermore, Figures 7 and 8 of Takeuchi et al. both of which show the process monitoring device, also show that the antenna loop is a single-turn coil. Thus, Takeuchi et al. does not teach energizing the gas by applying an RF current through a multi-turn antenna and monitoring radiation from directly above the surface of the substrate, as claimed in claims 21-25.

Claims 33-37

Takeuchi et al. does not teach independent claim 33 as amended, which recites, inter alia, powering the non-vertical multi-turn antenna to couple energy through the wall to the gas inside the process chamber to energize the gas, detecting radiation propagating through the wall, and evaluating the detected radiation to monitor the depth of a layer being processed on the substrate. Instead, Takeuchi et al. teaches detecting radiation using an antenna comprising a single loop. Furthermore, Figures 7 and 8 of Takeuchi et al. both of which show the process monitoring device, also show that the antenna loop is a single-turn coil. Thus, Takeuchi et al. does not render unpatentable, claim 33 or the claims dependent therefrom.

Claims 38-40

Takeuchi et al. does not teach independent claim 38, which recites, inter alia, coupling energy across the substantial portion of the external top surface to the gas in the chamber by powering the multi-turn antenna, monitoring radiation that propagates through the portion of the external top surface, and evaluating the monitored radiation to monitor the depth of a layer being processed on the substrate. Instead, Takeuchi et al. teaches detecting radiation in the context of an antenna comprising a single loop. Furthermore, Figures 7 and 8 of Takeuchi et al. both of which show the process monitoring device, also show that the antenna loop is a single-turn coil. Thus, Takeuchi et al. does not teach coupling energy across the substantial portion of the external top surface of a chamber to the gas in the chamber by powering the multi-turn antenna, and monitoring radiation that propagates through the portion of the external top surface. Thus, claims 38-40 are patentable over Takeuchi et al.

Claims 41-43

Takeuchi et al. does not teach claim 41 which is to a method of processing a substrate in a chamber comprising a flat wall facing the substrate and a multi-turn antenna at least partially covering the flat wall. The method comprises providing a substrate in the chamber, introducing a gas into the chamber, coupling energy across the wall to the gas in the chamber by powering the multi-turn antenna, detecting radiation that propagates through the flat wall, and evaluating the detected radiation to monitor the depth of a layer being processed on the substrate. Instead, Takeuchi et al. teaches detecting radiation in the context of an antenna comprising a single loop. Furthermore, Figures 7 and 8 of Takeuchi et al. both of which show the process monitoring device, also show that the antenna loop is a single-turn coil. Thus, Takeuchi et al. does not teach claims 41-43.

Claims 44-45

Takeuchi et al. does not teach claim 44 which is to a method of processing a substrate in a chamber comprising a wall facing the substrate, the wall being at least partially covered by a multi-turn antenna, a cathode within the chamber, and an RF power source. The method comprises providing a substrate in the chamber, introducing a gas into the chamber, applying an RF signal to the cathode and multi-turn antenna by powering the RF power source to form a plasma in the chamber, detecting radiation that propagates through the wall, and evaluating the detected radiation to monitor the depth of a layer being processed on the substrate. Takeuchi et al. does not teach applying an RF signal to the cathode by powering the RF power source to form a plasma in the chamber. Instead Takeuchi et al. teaches only a coil to power the plasma and does not teach using a cathode. Thus, Takeuchi et al. does not render claims 44-45 unpatenable.

Rejection Under 35 U.S.C. 102(b)

In the previous Office Action, the Examiner had rejected claims 1-7, 10, 12-22, 24, 25, and 33-45 under 35 U.S.C. §102(b) as being anticipated by Japanese Published Unexamined (Kokai) Patent Publication No. 58-33836 (hereinafter, Koizumi).

Koizumi does not teach independent claims 1, 10, 17, 21, 33, 38, 41 and 44, as amended, which recite detection (or monitoring) of radiation and evaluating the detected (or monitored) radiation to monitor the depth of a layer being processed on the substrate. Instead Koizumi teaches:

> "The intensity of light emitting spectra of plasma is detected. Based on the detected value, the flow volume of reaction gas, the pressure thereof and the power supply are controlled to control the plasma energy inside the asher device constantly at a specific level. By these means, a sufficient scum removal is performed to improve the yield in the production of a semiconductor device." (Koizumi translation, first full paragraph)

Thus, Koizumi teaches detecting the intensity of a light emitting spectra of plasma to

control plasma energy in the chamber, and does not teach evaluating the detected radiation to monitor the depth of a layer being processed on the substrate.

Koizumi further teaches that the detected light emitting plasma spectra is:

> "...compared with a predetermined reference value, [and] the size of the plasma energy is identified in the plasma energy at the time is larger or smaller than a predetermined energy. Accordingly, control the unit 13 operates as to control the plasma energy in a smaller or larger direction based on the aforementioned difference." (Koizumi translation, page 5, first paragraph.)

Thus, Koizumi uses detected light emitting plasma spectra to control the plasma energy in a smaller or larger direction based on the difference between the measured spectra and a predetermined reference spectra. Koizumi does not teach the step of evaluating the detected radiation to monitor the depth of a layer being processed on the substrate as claimed in the claims 1, 10, 33, 41 and 44. Koizumi also does not teach the steps of monitoring the radiation and evaluating the monitored radiation to monitor the depth of a layer being processed on the substrate as claimed in the claims 17, 21 and 38. Nor does Koizumi teach determining an endpoint of the process from the detected radiation as recited in claim 21. Thus each of these claims is distinguishable over Koizumi for the reasons provided above, and since Koizumi does not teach each and every element or step of the processes claimed in claims 1, 10, 17, 21, 33, 38, 41 and 44, Koizumi does not anticipate the present claims, or the claims dependent therefrom.

Rejection Under 35 U.S.C 103 (a)

The Examiner rejected claims 8, 9, 24 and 25 under 35 U.S.C. 103(a) as unpatentable over Koizumi in view of US Patent 5,807,761 issued to Coronel et al.

Claims 8 and 9 depended upon claim 1 and claims 24 and 25 depend upon claim 21. Koizumi does not teach claims 1 and 21, as amended, which recite detection of radiation (claim 1) or monitoring of radiation (claim 21), and monitoring the depth of a layer being processed on the substrate by evaluating the detected radiation

to monitor a depth of a layer being processed on the substrate. Instead Koizumi teaches detecting the intensity of light emitting spectra of plasma to control the plasma energy inside an asher device. Koizumi further teaches using the detected plasma spectra measurements to control plasma energy by adjusting the flow volume of reaction gas, the pressure thereof and the power supply. Thus, Koizumi does not teach the step of evaluating the detected radiation (claim 1) or monitored radiation (claim 21) to monitor the depth of a layer being processed on the substrate as claimed in the amended claims.

Coronel et al. does not make up for the deficiencies of Koizumi, because Cornell et al. does not teach energizing the gas by passing RF energy through a wall of the process chamber at a power sufficient to couple the RF energy from above an external surface of the process chamber to the gas inside the process chamber to energize the gas as claimed in claim 1. Instead, Coronel et al. teaches the "[t]he plasma is generated between the two electrodes..." which comprise the susceptor 23 and chamber wall. (Coronel col. 7, lines 24-29.) The two electrodes do not pass RF energy through a wall of the process chamber at a power sufficient to couple the RF energy from above an external surface of the process chamber to the gas inside the process chamber to energize the gas as claimed in claim 1.

The combination of Koizumi and Coronel et al. also does not teach or suggest passing RF energy through a wall of the process chamber at a power sufficient to couple the RF energy from above an external surface of the process chamber to the gas inside the process chamber to energize the gas, and detecting radiation thorough the wall and monitoring the depth of a layer being processed on the substrate by evaluating the detected radiation. Passing RF energy through a wall to energize a gas, while simultaneously detecting radiation passing through the same wall to monitor a depth of the layer, is counterintuitive, because the mechanism to generate and pass the RF energy through the wall may block the radiation, which also passes to the same wall to be measured. One would have to specially design the RF energy source so that it does not interfere with the passage of the radiation. Instead, it would be simpler and

easier to monitor the radiation through a different wall than that through which the RF energy is passed. Thus, one of ordinary skill in the art would not be motivated to combine the teachings of the two references as suggested by the Examiner to render obvious claim 1 and the claims dependent therefrom, absent some teaching that would suggest that such a combination is desirable.

The combination of Koizumi and Coronel et al. further do not teach claim 21 or the claims dependent therefrom, because the references do not teach powering an antenna to inductively couple RF energy at a power sufficient to pass RF energy from outside an external surface of a portion of the ceiling of the first enclosure facing the substrate to the process gas inside the first enclosure to energize the process gas, and monitoring a sufficient intensity of radiation from directly above the surface of the substrate from after the radiation has propagated through the portion of the ceiling and external surface of the first enclosure facing the substrate and into a second enclosure disposed above the first enclosure to monitor the depth of a layer being processed on the substrate to determine a process endpoint.

For these reasons, the combination of Koizumi and Coronel et al. do not render obvious the present claims.

The above-discussed amendments are believed to place the present application in condition for allowance. Should the Examiner have any questions regarding the above remarks, the Examiner is requested to telephone Applicant's representative at the number listed below.

Respectfully submitted,

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